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Intermittency in Growth as an Index of Health Status

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CHILDREN in the public schools are commonly weighed each month to observe growth, but their weights are no longer compared with height-weight averages to determine which children are "underweight." The present procedure is based upon studies^{1,2} which have shown the limitations of underweight as a health index, and upon experience which shows that the child's interest in watching his growth is a motivating factor in the development of health habits.

It is a recognized fact that growth among healthy children is a reasonably continuous process. What is the significance of intermittency?

We have sought to determine the answers to the following questions:

1. To what extent does intermittency occur among school children in the first 6 grades?
2. Is intermittency in growth usually associated with unhygienic living, physical defects or illness?
3. Can intermittency be used as a method of screening out public school children who need special attention?

Children in 6 of the elementary schools of Malden, Mass., were weighed once a month on the same day each month and at the same time of day, with shoes on, by the classroom teacher. A classroom weight record was kept of each monthly weighing.

In order to determine the amount of intermittency, we examined the records of 971 children, 6 to 12 years (see Figure I). For the school year 1929-1930 we found that 16 children, or 1.7 per cent of

FORM USED—INDIVIDUAL HEALTH CONFERENCE (1930)

1. Name
2. Grade School Teacher
3. Age
4. Last Height
5. Weights
6. Average Weights
7. Physical Record from Classroom Physical Record Card
 - A. Defects recorded by doctor
 - B. Corrected Date
 - C. Uncorrected
8. Illness during last 3 months
 - A. Nature
 - B. Time and duration
 - C. Absence from school
 - D. Medical care during illness
9. Teacher's Remarks
 - A. Frequency of absence
 - B. Nervous condition
 - C. Type of home environment
 - D. Interest and ability in work
10. Health Habits (Record of last 24 hours)
 - A. Intake and Elimination
 1. Number glasses of milk at home school
 2. Breakfast
 3. Lunch
 4. Dinner
 5. Candy
 6. Food between meals
 7. Amount of water
 8. Bowel movement
 - B. Rest Habits
 1. Bed time
 2. Rising time
 3. Time between supper and bedtime
 4. Activity before bedtime
 5. Number sharing room
 6. Number sharing bed
 7. Windows open
 8. Rest periods during day
 - C. Outside Activities
 1. After school
 2. Outdoor play
 3. Outside lessons
 4. Outside work
 5. Saturday and Sunday recreation
11. Additional Remarks
 - Number in family
 - Mother living
 - Father living
 - Father working
 - Any other members of family working

the group, had gained weight each month; 42.1 per cent of the group failed to gain in one or more monthly periods but never failed to gain over a 2-month period; 36.6 per cent failed to gain over one or more 2-month periods but never failed to gain over a 3-month period; 15.4 per cent failed to gain for a 3-month period but never for a 4-month

period; 3.3 per cent failed to gain for a 4-month period but never for a 5-month period; 0.9 per cent of the group failed to gain for 5 months in succession. Figure II shows that the distribution of intermittency for the different ages is approximately the same.

During the last half of the school year 1929-1930 we gathered additional data concerning 95 children (Group I) who had failed to gain for a period of 3 months within the school year. (Eight children in this group gained $\frac{1}{4}$ pound during the 3 months in question, the others showed no gain or loss.) In September, 1930, we gathered similar data concerning a control group of 100 children in the same schools (Group II) who had gained regularly, that is, children who had never failed to gain over a 2-month period during the preceding school year. Four of these children had shown a gain each month and none had failed to register a monthly gain more than twice.

The present study compares the children who failed to gain over a 3-month interval with those who gained regularly. The information concerning these children was secured from the physical record cards of the school system, and by means of a physical examination to which parents were invited. The scholastic ability of the child was rated by the teacher. At the same time an individual health habit conference took place between a health education worker and the child, and the child's program for the previous 24 hours was reviewed as an index of his health behavior. The nature of the data collected at these conferences may be seen from the form used.

Table I shows some interesting data regarding the nature of these children.

TABLE I
NATURE OF GROUPS STUDIED

	Group I	Group II
Number of children	95	100
Children of good mental ability	52	55
Children of fair mental ability	23	26
Children of poor mental ability	20	18
Large family (5 or more)	51	59
Families with more than one wage earner	4	12
Children whose mothers work	14	10
Fathers out of work	5	6
Fathers not living	5	4
Mothers not living	2	3
Children working outside daily	7	5
Children working outside one day or more weekly	12	6
Children taking some outside lessons	26	29
Parents present at physical examination	56	56

The distribution of good, fair and poor students was practically identical in the two groups. There was no appreciable difference in the number of parents who attended the physical examinations, in the

FIGURE I

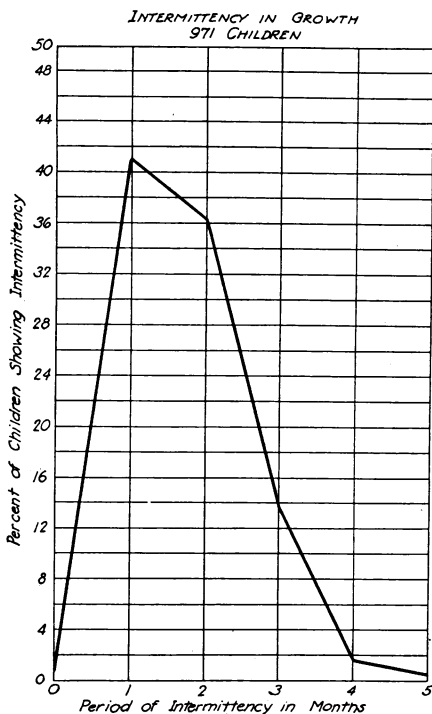
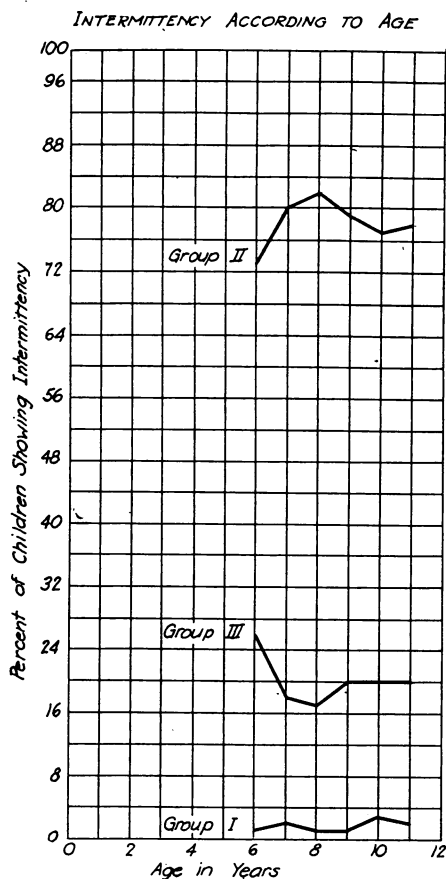


FIGURE II



number of children taking lessons of some sort outside of school, in the number of children coming from large families, or in the number of children whose father or mother was not living. There is some suggestion that the children in the consistently gaining group

were in somewhat better economic situations because in more cases there was a second wage earner in the family, in slightly fewer cases were the mothers gainfully employed outside the home, and in somewhat fewer cases were the children regularly and gainfully employed outside of school. In short, these two groups of children taken from the same schools seem alike in mental ability, in general home and social conditions, and not greatly different in economic status.

Since the children studied were drawn from a rather wide age group, Table II is inserted to show the distribution according to age.

In gathering information concerning the habits of the children during a 24-hour period, care was taken to avoid any embarrassment on the part of the child in stating frankly what had taken place. Pupils

Group I - No Intermittency (13 Children).
 Group II - 1 Mo. or 2 Mo. Intermittency (140 Children).
 Group III - 3 Mo. or Longer Intermittency (187 Children).

TABLE II

AGE DISTRIBUTION AT BEGINNING OF PERIOD OF STUDY

Age	Group I	Group II
6	13	15
7	24	17
8	14	16
9	11	22
10	14	16
11	10	8
12	7	6
13	2	0
	<hr/> 95	<hr/> 100

can remember what they did during 24 hours preceding the conference, and experience has shown that much more accurate data can be obtained in this way than by inquiring what they "usually do." See Table III.

It will be seen that faulty health behavior was much more common in the children who had failed to gain over a 3-month period. In comparing breakfasts we find that Group I showed twice as many children who failed to have milk. The difference in the numbers of children having cereal or bread is probably not significant since one is often a

TABLE III

A COMPARISON OF HABITS BASED ON THE STUDY OF A 24-HOUR PERIOD

	Group I	Group II
Number of children in group	95	100
Having for breakfast—		
No cereal (egg allowed as substitute)	20	27
No milk or cocoa	32	14
No toast or bread substitute	20	13
No fruit	65	71
Having no meat, fish or egg protein	27	12
Having less than 3 glasses of milk *	51	34
Having no vegetables besides potato	47	34
Having no fruit	52	34
Having tea or coffee	6	5
Having inadequate sleep	31	20
Having less than 4 glasses of water	38	50
Having no bowel movement	4	4
Having no outdoor exercise	7	6
Having windows closed at night †	15	3
Having no fruits or vegetables besides potato	29	14
Having less than 3 glasses of milk and no meat, fish or egg	13	5
Having inadequate liquid (less than 4 glasses of water and less than 3 glasses of milk)	21	17
Having inadequate milk and no fruit or vegetable	21	6
Having no cereal or bread for breakfast	3	4
* Of this group those who had no milk or cocoa for breakfast were	28	11

† These figures are not comparable because the data for Group I were taken in the winter and those for Group II in September.

substitute for the other, and since we find only 3 in Group I and 4 in Group II who did not have either cereal or bread. There is only a slight difference in the number of children who failed to have fruit for breakfast, but 52 in Group I failed to have any fruit during the day, while only 34 in Group II reported such failure. Group I had 17 more children than Group II who received less than 3 glasses of milk, and 15 more who had no source of protein except milk.

When we look up the number of children who had less than 3 glasses of milk and no other protein, we find 13 in Group I and 5 in Group II. We find 29 in Group I who had neither fruit nor vegetables besides potato, but only 14 in Group II. There was no significant difference in the number of children who had tea or coffee, the number who failed to have a bowel movement, or the number who failed to play out of doors. Nearly all in both groups had a satisfactory record in these respects.

Appreciably more of the children who had failed to gain showed inadequate hours of sleep. (Inadequate sleep was based on the following standard: $11\frac{1}{2}$ hours at ages 6 and 7, 11 hours at ages 8 and 9, $10\frac{1}{2}$ hours at ages 10 and 11, 10 hours at ages 12 and 13.)

The question of liquid intake is somewhat confused by the fact that some children may substitute milk for water at certain times of the day. In order to determine the number of children having inadequate liquid, therefore, we determined the number who had less than 4 glasses of water and less than 3 glasses of milk, finding 21 in Group I, and 17 in Group II.

In order to secure some index of the number of children having low vitamin intake, we checked those having less than 3 glasses of milk and no fruit or vegetable during the day. There were 21 in Group I and 6 in Group II.

In order to get data on the more serious faults let us compare the children with respect to 5 items of behavior: (1) inadequate protein (less than 3 glasses of milk and no meat, fish or eggs), (2) low vitamin intake (less than 3 glasses of milk and no fruit or vegetables), (3) inadequate sleep, (4) inadequate liquid (having less than 4 glasses of water and less than 3 glasses of milk), and (5) deficient roughage (having neither fruit nor vegetable besides potato). Table IV shows the number in each group deficient in none, 1, 2, 3, 4 or all 5 of these. The number of children in Group I whose health practices were at fault with respect to 2 or more items is 33 as compared with 12 in Group II. The reader may be struck by the fact that 33 of the children who had failed to gain were at fault in none of these particulars. Most of these were suffering from recent illness or from physical defects.

Of course these data do not pretend to present a complete, accurate, and adequate picture of health behavior in the two groups; but they do show a significant difference.

TABLE IV

NUMBER OF CHILDREN HAVING INADEQUATE PROTEIN, VITAMINS, SLEEP, LIQUID OR ROUGHAGE

No. Items Wrong	Children in Group I	Children in Group II
0	33	54
1	29	34
2	18	8
3	8	4
4	5	0
5	2	0
Total	95	100

Table V compares the two groups of children with respect to the number of physical defects sufficiently serious, in the judgment of the examining physician, to require correction or treatment.

TABLE V

PHYSICAL DEFECTS REQUIRING CORRECTION

	Group I	Group II
Number of children	95	100
Enlarged cervical glands	2	0
Posture (drooping)	8	1
Nutrition	4	2
Teeth	49*	48*
Feet	1	1
Tonsils	12	6
Tonsils (corrected)	45*	60*
Scalp	1	0
Sight	0	2
Eyes (not vision)	1	0
Hearing	5	1
Ears (not hearing)	3	2
Skin	4	1
Heart	1	0
Lungs (dullness)	2	0
	44	16

* Items not included in totals.

It will be seen that there were nearly 3 times as many physical defects in Group I as in Group II. A few items are especially worthy of note. The only defect more common in Group II than in Group I was vision. On the other hand, defects of the lungs, heart, and cervical glands occurred only in Group I, and defects of hearing, skin, tonsils, posture and nutrition were relatively more common among these children whose growth record was poor. The number of cases of seriously defective nutrition was small. The basis of this diagnosis was the judgment of the physician using many indexes, including particularly

the condition of the subcutaneous tissue. If the fallacious practice of diagnosing malnutrition upon the basis of 10 per cent underweight had been followed, we should have recorded approximately 40 such children. It is interesting that appreciably more children in Group II had had corrective treatment for diseased tonsils.

Of course physical defects varied in severity; not every physical defect would interfere with growth; and the same type of physical defect might or might not interfere with the growth of a child according to his health status in other respects, or according to whether or not his mode of living was sufficiently good to allow him to overcome the drain which this defect might put upon the system.

Table VI shows the number of children with 1, 2, or 3 of the above defects.

TABLE VI
DISTRIBUTION OF PHYSICAL DEFECTS (TOOTH DEFECTS NOT INCLUDED)

Number of Defects	Number of Children	
	Group I	Group II
1	14	12
2	9	2
3	4	0
Total	27	14

Records of the illnesses of these groups of children were secured. For Group I we have data for the 6 months during which the intermittency of growth occurred; for Group II for the 10 months of the school year. Table VII shows that when reduced to the same time basis, the incidence of disease was almost twice as great in Group I as in Group II, while the incidence of common cold was over 4 times as great. The non-communicable diseases or conditions in Group I re-

TABLE VII
ILLNESSES

	Group I		Group II	
	No. Cases	Av. No. Cases Monthly	No. Cases	Av. No. Cases Monthly
Children studied	95		100	
Months included in study	6		10	
Cases of cold and gripe	28	4.6	11	1.1
Chicken pox	6	1.0	5	0.5
Whooping cough	9	1.5	11	1.1
Scarlet fever	0	0	1	0.1
German measles	0	0	1	0.1
Mumps	3	0.5	8	0.8
Illnesses from non-communicable diseases	9	1.5	11	1.1
Total number of cases	55	9.1	48	4.8

ceiving treatment included tonsillectomy, digestive difficulty, tonsillitis, asthma, swollen glands, and ear trouble, while in Group II they included tonsillectomy, tonsillitis, severe nose bleed, appendectomy, ear trouble, fractured skull, burn.

A disease might or might not interfere with growth according to its severity, the care received by the patient, or the condition of the child in other respects.

We have seen that the children who have gained regularly have a superior record in habits, illness, and physical defects. It seems worthwhile to compare the number of children in the two groups suffering from deficiencies in each of these respects and from combinations of such deficiencies. Table VIII gives the result of such a study.

TABLE VIII
COMPARATIVE CONDITIONS OF CHILDREN

Health Deficiencies	Number of Children	
	Group I	Group II
None observed	4	17
Defective teeth and one faulty habit only	18	24
Two or more faulty habits only	8	6
Illness only	27	36
Physical defects only	4	9
Poor habits and illness	12	4
Poor habits and physical defects	8	1
Illness and physical defects	8	2
Poor habits, illness and physical defects	6	1
	<hr/> 95	<hr/> 100

It should be explained that the basis of judging habits here is that used in Table IV and the children are divided into habit groups according to whether they are at fault in none, 1 or more of the 5 fundamental health practices mentioned. Considering faulty habits, illness and physical defects, it will be seen that most of the children in Group II suffer from only 1 of these conditions, only 8 per cent of these children being deficient in more than 1 respect, whereas 36 per cent of the children in Group I are deficient in 2 or in all 3.

SUMMARY

The extent to which children fail to gain over different periods of time was determined. Weighings would have been somewhat more accurate without shoes. It is probable that because of the more rapid growth at the adolescent period these findings for elementary school children would not apply to those in the junior and senior high school.

Children who have failed to gain for a 3-month period reflect appreciably poorer health habits and definitely lower health status than

those who have gained regularly. Nearly 3 times as many in the former group (33:12) have 2 or more important unhygienic habits; serious physical defects are nearly 3 times as numerous among them (44:16); nearly twice as many (27:14) have such defects; illness is nearly twice as common (9.2:5). The number of children defective in 2 or all 3 of these respects is over 4 times as great (34:8).

Intermittency in gaining weight does not draw a sharp line between the children who seem to need attention and those who do not; but it is more commonly accompanied by departure from normal health than is regular growth. (Obese children usually gain regularly and too rapidly. This screening is not applicable to them.)

There are always differences in the seriousness of the defects recorded and in the vitality of individual children. The relatively few who showed regular gains, although burdened with a combination of unhygienic habits, illness and defects, appear to have had sufficiently good natural vitality or home care to maintain growth in spite of these conditions.

A few children, 4 per cent, showing intermittency for 3 months, exhibited no departure from normal. A somewhat larger group, 18 per cent, showed only minor difficulties. It may be that our studies failed to reveal existing defects, unhygienic habits or departures from normal organic health. It may be that nervous fatigue, worry over school work, or some other unobservable factor interfered with growth. It may be that a few children who are maintaining a reasonably satisfactory state of health show intermittency to this degree.

CONCLUSION

Since school children are weighed regularly anyway and since children who have failed to grow for a 3-month period show a much poorer condition in respect to habits, illness and physical defects, it seems worthwhile for the teacher, school nurse and school physician to give them individual attention in order that unhygienic living may be discontinued, complete recovery from illness secured, physical defects corrected, and in order that children needing continuing medical care may be referred to the family physician.

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